ASSOCIATION OF
FEDERAL COMMUNICATIONS CONSULTING ENGINEERS
WASHINGTON, D. C.

January 21, 1994

Mr. William Caton, Secretary
Federal Communications Commission
1919 M St., N.W.
Washington, D.C. 20554

Re: ET Doc No. 93-62

Dear Mr. Caton:

Transmitted herewith for filing with the FCC are the original and four copies of the comments of AFCCE in the above referenced matter. Also enclosed is an additional "return copy" and stamped addressed envelope. Please mail an FCC date stamped copy in this envelope for our records.

If any questions arise in this matter, please contact the undersigned.

Sincerely,

Robert Culver

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of

Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation	)))	ET Docket No. 93-62

COMMENTS OF THE ASSOCIATION OF
FEDERAL COMMUNICATIONS CONSULTING ENGINEERS
FCC NOTICE OF PROPOSED RULE MAKING

INTRODUCTION

The Association of Federal Communications Consulting Engineers (AFCCE) is an organization that includes approximately 80 full members, who are registered professional engineers engaged in the practice of consulting engineering or are communication company engineering executives, together with approximately 120 associate and other members, most of whom are engineers employed by equipment manufacturers.

AFCCE was organized in 1948 and has, for over four decades, been pleased and honored to share its professional experience and insight with the Federal Communications Commission.

AFCCE supports the goal that the FCC Rules should, from time to time, be reviewed, and if necessary, revisited in light of new technical advances in the art of communication. The resulting revision, if any, should provide for the more efficient regulation and operation of the communication industry. The communication services which have evolved are structured on these technical rules and modifications which impact operations, the ability of licensees to easily understand and comply with the rules and the ability of the FCC to administer the rules, should be approached with care. In the present Notice of Proposed Rulemaking (NPRM), FCC ET Docket 93-62, the proposed changes are based on an extensive review of scientific data by members of ANSI and IEEE technical

committees.

AFCCE supports the Commission's proposal to use a new standard for evaluating the environmental effects of RF exposure, similar to that approved by the Institute of Electrical and Electronic Engineers (IEEE) and adopted as American National Standards Institute (ANSI) as standard ANSI/IEEE C95.1-1992, and the other standards organizations cited in the NPRM. These changes generally may add to the direct burden of broadcasters regarding compliance certification. The FCC should strive to minimize the burden and to make the new rules as easy to understand and comply with as possible while still providing the environmental protection desired. To do otherwise will be self defeating in that rules that are difficult to understand and comply with may be ignored by some licensees. Finally, the IEEE Standards Coordinating Committee 28, charged with writing and updating the standard, meets on a regular basis for this purpose. Therefore, IEEE for one, refers to the proposed guideline as a "living document", anticipating review and revision from time to time. The FCC will be required to implement procedures to accommodate such updates, also in an efficient and acceptably less burdensome process.

The burden imposed on broadcasters can be mitigated to some extent by well devised procedures that permit effective prediction of exposure and definition of threshold exposures above which specific exposure avoidance or reduction measures are required. Those procedures, for use by both engineers and station personnel, should be embodied in a new document similar to the present OST Bulletin No. 65. That document will also be required to be updated from time to time as the exposure guideline may change. There is no way the impact of a periodic revision of the guidelines could be removed; it can only be lessened by controlling the degree and frequency of such revisions.

It is clear that the resulting FCC adopted guidelines will have a direct impact on radio operations. In the following sections AFCCE will present some of the interrelated topics of RF Exposure, briefly explain the anticipated impact and suggest a course of reasoned consideration to resolve the conflicts and lessen the impact of the proposed guidelines.

CONTROLLED VS. UNCONTROLLED ENVIRONMENTS

The ANSI/IEEE standard defines these two environments in the following text:

> "Controlled environments are locations where there is exposure that may be incurred by persons aware of the potential for exposure as a concomitant of

employment, by other cognizant persons, or as the incidental result of transient passage..."

"Uncontrolled environments are locations where there is the exposure of individuals who have no knowledge or control of their exposure. The exposures may occur in living quarters or work places."

The exposure limits proposed for these two environments can be stated in clear mathematical terms of E and H field and the necessity for a reduced "public" exposure level will not be argued here. The interior of buildings devoted to broadcast equipment, where access is permitted only to maintenance or operating personnel, clearly fall into the controlled category. Similarly, the immediate vicinity of a transmitter site, with posted warning notices, access barriers and including remote locations, also clearly are controlled environments under the "other cognizant persons" definition. Nearby areas where "transient" passage is allowed likewise should be classified as controlled environments.

At the other end of the scale of environments, however, private residences and adjacent private and public spaces and buildings, where people normally live or gather for extended periods of time, fall into the uncontrolled environment category. Offices and work places not normally associated with broadcast transmissions (or other RF sources) would likewise be classified as uncontrolled. On a smaller scale the operators of portable transmitters have knowledge and control of their environment and therefore fall into the controlled category. Persons nearby, however, may not have knowledge and control and their presence may not be "transient" and therefore might be considered "controlled" environment individuals. It is here, in the broad range between the two environments, and not clearly associated with one or the other, that the controlled vs. uncontrolled environment question becomes difficult.

AFCCE supports adoption of common sense definitions and distinctions between these two environments. The Commission may need to take extra effort to clarify categories of potentially confusing usage, such as for hand held devices used by the general public. In that case the use is not a "concomitant of employment", and while the person is clearly "in control" he may not be "aware" of exposure. Guidance on this issue will be needed in any replacement for OST 65. AFCCE recommends a dialogue with the FCC, AFCCE members and other engineers to adopt efficient guidelines and then create effective guidance documents.

CATEGORICAL EXCLUSIONS / LOW POWER DEVICES

At paragraph 18 of the Notice the Commission proposes:

> For purposes of the exclusions that are based on radiated power, we propose to exclude only those low-power devices that meet the uncontrolled guidelines. However, the exclusions based on SAR [Specific Absorption Rate] could apply according to the actual situation or "environment" in which a device is used.

This proposal has an inconsistency. The proposed standard permits showing compliance by either the radiated power criterion or SAR. The Commission says that it will apply uncontrolled environment standards if the intent is to show compliance by the limiting of radiated power, but will take into account conditions of exposure if compliance is based on SAR. No matter which of the two routes is used to show compliance, the circumstances of the use should apply. The inconsistency lies in not taking into account the circumstances for use when compliance is by radiated power. An example would be when hand held units are used in news gathering. The use is certainly a "concomitant of employment" and, if instructed, the user is certainly "aware" of the exposure. Why should anything other than the controlled environment criterion apply, no matter how the manufacturer has qualified the equipment as meeting the standard?

When a manufacturer claims compliance certification under the SAR limits rather than power, he should be required to describe with specificity the conditions under which compliance is claimed, including the recommended use of the device and the test conditions under which the SAR was determined. Sufficient information will have to be provided to the user to assure that the recommended uses are followed and that if any physical use would result in an overexposure based on SAR, that use would have to be prohibited. Finally, this information would be required to be included in the authorization process for the manufacture of the device. This situation is similar to that of the Food and Drug Administration (FDA) regulating medical devices where safety, effectiveness and proper use are considered.

Devices now available and in use will have to be addressed in light of the new guidelines. Where a device can be categorically excluded based on power , no further action is necessary. Where a device requires certification of compliance based on SAR, the manufacturer should supply the certification and required use instructions in a certain acceptable time. Where neither exclusion can be shown for the device as it exists, the manufacturer must modify the device or restrict its "recommended use" to comply.

Otherwise, the device should eventually be removed from service. Clearly, present uses should be grandfathered with an acceptable time to supply certification, modification or phaseout of the device. This time can range from several months for the former, to several years for the latter.

CATEGORICAL EXCLUSIONS / OTHER DEVICES

The present guidelines contain categorical exclusions for most facilities under part 74, Broadcast Auxiliary Rules and other similar facilities in non-broadcast Rule sections. Facilities such as: remote pickup, studio to transmitter links, inter city relays, microwave boosters, and translator stations all share similar characteristics which argue for their continued categorical exclusion. They are relatively low power, often hand held and intermittently operated, remotely located on roofs or tall towers if base stations and similarly inaccessible if mobile transmitters. As a class they represent a significantly lower potential for RF exposure than higher power continuously operated broadcast transmitters.

Hand held devices, as discussed above, would be expected to comply with the categorical exclusion for low power devices. Mobile vehicle mounted devices may operate with transmitter powers up to 100 watts, but typically operate at approximately 30 watts or less. With 30 watts of transmitter power and a low gain antenna, the uncontrolled exposure radius extends just over 1 meter and for 100 watts power extends approximately 2.6 meters. Exposure within the closer distance would require an individual to be positioned immediately along side a vehicle of only modest size. Exposure for the full 30 minute averaging period allowed in the proposed guidelines, for both time of transmission and position, is highly unlikely with the mobile transmitter. Considering the unlikely occurrence of exposure at levels and durations necessary to exceed the time averaged uncontrolled environment guidelines, AFCCE recommends that such transmitters be categorically excluded.

Low power base station transmitters pose an equally low potential for exposure. Assuming a 100 watt transmitter and a broad vertical beam unity gain vertically polarized dipole antenna, the proposed exposure guidelines will not be exceeded for either environment if the antenna is located just 3 meters above a surface upon which an individual may stand. As with all elevated sources, closer approach would be made only by authorized individuals climbing a supporting structure in a controlled environment and under work rules adopted to prevent excessive exposure on those occasions.

Similarly, aural STL's with transmitters of 10 watts may achieve ERP's from 100 to 1000 watts with typical antennas, resulting exposure distances from approximately 7 to 24 meters in the main beam. With elevated antennas, where the main beam is well above ground level and access is only possible to the sidelobe patterns, that distance falls to approximately 0.5 to 2.5 meters. Television microwave relays fall into the same general category, with higher gain main lobe antennas offset by the combination of higher allowed exposure, lower transmitter power and decreased side lobe energy at higher frequencies.

AFCCE recommends that the FCC review all low power transmissions relative to their technical parameters and recommended usage for their resulting exposure potential. From that review, categorical exclusion should be allowed for those, as in the above examples, which pose little or no potential for exposure in excess of the guidelines. Involvement of the communications industry in the review process would ensure that all transmitter types and recommended uses are considered.

EXPOSURE PREDICTION METHODS

For devices not granted categorical exclusions as discussed above, a set of concise prediction methods, including both an OST 65 type bulletin and formula must be available to broadcasters and engineers. Over the years of use, the accuracy of parts of FCC OST Bulletin 65 has been proved by measurement. Other parts, however, have been shown to be inaccurate, overestimating exposure potential by a considerable degree. As an example, the charts and graphs related to VHF exposure do not agree as well with actual measurements as do the predictions based on the formulas, from the Galley and Tell 1985 EPA report, also given in OST Bulletin 65. Considering the possible increased complexity of the new RF Exposure guidelines, a substitute OST Bulletin must be available in advance of the effective date of those guidelines. The experience with OST Bulletin 65, together with discussion and suggestions on its replacement will resolve most of the past prediction method problems. AFCCE recommends a cooperative effort with the FCC staff and industry engineers to achieve the required guidance documents.

MEASUREMENTS AND EXPOSURE AVOIDANCE RELATED ISSUES

The proposed exposure limits are based on Specific Absorption Rate (SAR) which in turn is determined by the incident power density, among other factors, to which an individual is exposed. Today, there are no instruments which directly measure real power density, although an instrument that properly relates the E and H fields to determine the real power density is suggested by the paper by Grassman and Furrer[4]. The FCC has

recommended consideration of ANSI/IEEE C95.3-1992, "Recommended Practices for the Measurement of Potentially Hazardous Electromagnetic Fields" as guidance for making measurements. Like the ANSI/IEEE exposure guidelines, this document is a "living document" subject to revision from time to time. The FCC will have to modify its exposure avoidance procedures when future changes in both the measurement procedures and the guidelines occur.

This ANSI/IEEE document clearly discusses the problems of making measurements, especially in near field conditions, which will result in incorrect and misleading exposure estimations. AFCCE supports the inclusion of extensive guidance on measurement practices in any replacement for OST 65 or another document.

In cases where measurements indicate that overexposure can not be avoided in certain required maintenance cases, the alternative of protective clothing is becoming an option. At least one manufacturer has a protective suit available, made of synthetic fabric with conductive microfilaments woven into it. In general the suit is claimed to allow exposure in certain frequency bands at up to ten times the incident field or power density limit without resulting in excessive exposure. Use of a passive barrier control, such as a suit, must be carefully considered, however, to assure that accidental overexposure does not occur. The suit must be used and maintained in strict compliance with the manufacturer recommendations and only by knowledgeable users.

Recently, personal monitors and dosimeters have appeared on the market. One such device is accompanied by apparently misleading advertising claims and similarly inaccurate labeling. Specifically, the claims purport that the monitor, without qualification, tests for exposure at a certain percentage threshold of the ANSI/IEEE C95.1-1992 standard. Actually the device only monitors the magnetic field component, at one point on the wearer's body. Clearly only a small part of the anticipated new guidelines are addressed.

In general, active controls, such as reduced power or suspended operation during work, is preferable over passive barriers. In marginal conditions accurate continuous monitoring is also indicated. Instruments designed for general use for exposure monitoring must give reliable and accurate results under all suggested uses. A self test and failure alarm, as described in the present OST 65 document, are strongly recomended. Prohibited uses and precautions for all items must be clearly stated. If the use of clothing and personal general instruments is permitted under new exposure rules, AFCCE urges the FCC and other appropriate federal agencies to study this matter and to set forth appropriate requirements for use, labeling and instructions to the users.

CONTACT CURRENTS

The proposed guidelines specify contact current limits for frequencies below 100kHz. At AM frequencies the only real contact current exposure sources are directly energized components or large conducting objects in the immediate vicinity of a broadcast antenna. The objects must be a significant portion of a wavelength in size and located sufficiently close to the RF source to induce a proportionally large voltage in the object. Cranes, power poles and other large objects may be contact current sources. Smaller objects such as fences, sign posts and flag poles, especially if farther removed from the antenna, generally would not be sources of excessive contact currents. In any event, the potential for creating a contact current in excess of the guideline would be proportional to the object size, shape and the incident E and H fields.

High Frequency band facilities, with multi-kilowatt transmitters at higher frequencies, will pose an increased risk of contact current exposure. As a result, while contact currents must be measured at significant large objects and/or objects close to AM antennas, measurements may be also be indicated for smaller objects somewhat farther removed from HF antennas.

Continuing up to the VHF spectrum, the size of objects which could present an exposure potential is less but the effective induced voltage is also less because of that smaller size. Finally, the ability of the contact current to contribute to power adsorption in a volume of tissue decreases with frequency, hence the contact current limit at 100MHz.

This topic of contact currents revolves around several issues. First there are no commercially available instruments to reliably measure contact currents. The method described by Richard Tell, using a tunable RF voltmeter and an inductive hand held pickup probe, can be used, but its limited utility in a multiple frequency source area is obvious. A reliable, easily understood and conveniently used instrument must be available. This instrument would be used as an area survey meter or a personal warning meter and would be used to test the area around a transmission site for compliance with the guidelines. For such use, the user would become part of the circuit monitoring the current.

However, the absence of any time averaging provision in the contact current limits may not allow for entering an area in which the current might exceed the threshold if the only means of measuring and monitoring current is by instrumentation in which the body is part of the circuit. Once an individual has contacted the object to observe the current, if it exceeds the threshold, the overexposure has already occurred. A reasonable time

averaging interval would relieve this. It should be long enough to make a decision about what objects in an area to avoid or what climbing path to take but not so short as to demand rash action in a potentially hazardous climbing situation. As an alternative a suitable current limiting resistor in the instrument would protect the body circuit from overexposure but the user must be aware that overexposure would likely occur for contact without the instrument or if the instrument were to malfunction allowing higher current to flow without indicating an overexposure situation

Finally, the presence of the VHF contact current upper frequency limit at 100MHz has placed the FCC in a dilemma from which it can not easily escape. The presence of RF sources both above and below that frequency at common or closely spaced sites will demand that all sources be included as potential contact current sources regardless of their frequency. For the Commission to change the contact current frequency limit from 100Mhz to either the top or the bottom of the FM band will require the FCC to make a "scientific" judgement that the Commission has in the past refused to make because of lack of expertise. If the contact current upper frequency limit were set at 88MHz, then no FM transmitters would be included and many "antenna farm" sites would be excluded. If the frequency limit remains at 100 MHz, then all FM stations, and perhaps all co-located transmitters, are forced to be included in contact current considerations. The FCC may be forced to adopt this arbitrary position despite its lack of expertise.

The Notice of Proposed Rulemaking states that the FCC intends to draw on input from many technical and regulatory sources and is considering using recommendations from other R.F. Exposure guidelines in addition to IEEE/ANSI guidelines. Issues such as this can only be resolved by involving those experts who have performed or have intimate knowledge of contact current research. With respect to contact currents in individuals and tower climbers, references 2 through 7 are useful. AFCCE supports the careful consideration of all contact current issues by way of a cooperative effort of the FCC and qualified individuals in considering the guidelines to be specified and ultimately in writing procedures in a replacement for OST Bulletin 65

INDUCED CURRENTS

The proposed guidelines recommend other body current limits, this time the induced current flowing through a free standing individual who is not in contact with conducting objects. This current induction is caused by the individual acting as a monopole antenna over ground with its magnitude affected by the height and shape of the individual, the incident fields, frequency and grounding conditions. In this case the area of possible injury

is through RF burn to the feet or exceeding the current exposure limits in the ankles. The induced current guidelines appear to be an excessively worst case condition. Clearly, where the fields are quite low relative to the exposure guidelines, measurement of induced current should not be required. References 2 through 5 provide a basis for establishing thresholds of electric field strength below which induced currents will not exceed the exposure standards.

AFCCE supports consideration of induced body currents in relation to field strength limits as a protection guideline. It recommends that field limits below which induced currents need not be considered be determined and incorporated in the adopted guidelines and included in any new technical bulletins.

EFFECTIVE DATE AND OTHER ISSUES

AFCCE recommends a modest delay between the adoption of new rules and the effective date. The time required to complete FCC applications for new or modified facility permits or licenses can easily take several months. A delay of 60 days would be appropriate to avoid having to rework applications in progress at the day of adoption of the new rules.

With respect to operations in progress on the effective date of new rules, no changes or certifications should be required until the operator files with the FCC an application for change or relicensing. This procedure was used at the adoption of the original exposure guidelines and would still be appropriate. However, installations with the high probability of exceeding the new rules must continue to be brought to the attention of the FCC for review and modification and/or recertification of compliance as necessary.

All certifications of compliance to the FCC should be accompanied by at least a brief statement providing the reasoning, methods, data and results behind the certification. Its detail should be sufficient to clearly support the methods and state the qualifications of the individual making the certification.

INTERRELATED QUESTIONS AND ANSWERS: A REASONED APPROACH

The proposed guidelines contain many interrelated topics, each of which must be addressed before answers can be proposed. Often those answers will be used as input to the questions on which other answers will be dependent. For example, the question of categorical exclusion is dependent on the question of controlled vs. uncontrolled environments.

Resolving many simultaneous and interrelated topics will require a cooperative effort between the FCC and industry to adopt guidelines and guidance to the users that, while achieving the environmental protection sought, is also unambiguous and easily implemented. That guidance should minimize the impact on the communications industry, making compliance methods and situations clear cut, and reserving only to those exposure cases not easily resolved by Guidance Documents the need for extensive measurements.

Respectfully submitted,

by: Robert Culver

Robert D. Culver, P.E.
AFCCE President

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2. "Data Analysis of VLF Hazards Study"; Bioelectromagnetics Laboratory, Center for Bioengineering, College of Engineering, School of Medicine, University of Washington, Seattle, WA. 98195; Prepared for Engineering Experimental Station, Georgia Institute of Technology, Atlanta, GA. 30331; Final Report; April 10, 1987.

3. D.A. Hill and J.A. Walsh; "Radio-Frequency Current Through the Feet of a Grounded Human"; Transactions on Electromagnetic Compatibility; Vol. EMC-27, No.1, pp. 18-23; February 1985.

4. J.Y. Chen and O.P. Gandhi; "RF Currents Induced in an Anatomically-Based Model of a Human for Plane-Wave Exposure (20-100 MHz)"; Health Physics; Vol. 57, No.1, pp. 89-98; July 1989.

5. S.Tofani, G.D.Amore, G.Fiandino, A.Bededetto, O.P.Gandhi and J.Y.Chen; "Induced Foot-Currents in Humans Exposed to Radio-Frequency EM Fields"; Advance copy of paper submitted for publication in Transactions on Electromagnetic Compatibility.

6. R. Cleveland, Jr., E. Mantiply, R. Tell; "A Model for Predicting Induced Body Currents in Workers Climbing AM Broadcast Towers"; Presented at the Twelfth Annual Meeting of the Bioelectromagnetics Society, San Antonio, Texas; June 12, 1990 (Abstract p. [illegible])

7. R Tell; "Induced Body Currents and Hot AM Tower Climbing: Assessing Human Exposure in Relation to the ANSI Radio Frequency Protection Guide"; Prepared for the Federal Communications Commission, Office of Engineering and Technology; October 7, 1991.